MOTIVATING UNDERGRADUATES IN SCIENCE AND TECHNOLOGY (MUST)

Administered by the Hispanic Scholarship Fund Institute, Inc.
Type of Agreement: Cooperative Agreement

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Data provided in this update can be found in two reports developed by RTI International, "Motivating Undergraduates in Science and Technology: 2013 Annual Report" and in the "MUST 2012-13 Evaluation." The update is also supported by MUST scholar records at the Hispanic Scholarship Fund Institute.

PROJECT DESCRIPTION

The NASA Motivating Undergraduates in Science and Technology (MUST) Project is an activity element within the Minority University Research and Education Project (MUREP). MUREP enhances the research, academic, and technology capabilities of Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs), and other Minority Serving Institutions (MSIs). Multiyear grants awarded to MSIs assist faculty and students in research pertinent to NASA missions.

MUST is managed by NASA John H. Glenn Research Center at Lewis Field and administered by the Hispanic Scholarship Fund Institute (HSFI). MUST is a multi-year initiative to develop undergraduate skill sets and expertise critical to the future Science, Technology Engineering, and Math (STEM) workforce and mission of NASA. It is the onl undergraduate scholarship program at NASA that is dedicated to underserved and underrepresented students and is renewable through college graduation.

Number of students served:	74
Age group:	Undergraduates
Project focus:	All groups underserved in STEM

RESEARCH-BASED PROJECT MODEL

MUST offers proven and intensive interventions for underrepresented and underserved students in STEM. The National Academies report *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (2010) found that successful college retention and workforce entry programs include research experiences, professional development activities, mentoring, academic support and social integration. *Expanding Underrepresented Minority Participation* also offers three additional recommendations for a successful national effort to increase the participation and success

of underrepresented minorities in STEM; they include *access and motivation*, *affordability* and *academic and social support*.

Access and Motivation

Individualized Student Support: A dedicated team of two HCF staff members works on a personal level with each MUST Scholar to support them through college. They provide individual monthly follow up and a monthly newsletter highlighting scholar achievements, opportunities in NASA education, in addition to professional development opportunities with STEM associations and conferences around the nation.

NASA Internship Experience: MUST Scholars participate in a 10-week internship at one of NASA's ten nationwide centers. Scholars are matched with a mentor and receive an internship stipend of $6,000.

Affordability

Scholarships: Project participants receive a scholarship of up to half of tuition and fees, not to exceed $10,000 per year. The scholarship is renewable through college graduation provided that all eligibility criteria continue to be met.

Academic and Social Support

Professional Development Training: In the 2012-2013 academic year all MUST scholars had already participated in at least two 21st Century Leadership Symposia. This multi-day conference offered scholars a project orientation and professional development workshops. MUST Scholars also had the opportunity to present their research, share experiences with their peers, and meet with NASA Center representatives to learn about internship opportunities. To build on their past symposia experience, MUST scholars received a new opportunity to enhance their résumés and professional skills. Each student selected and participated in one of the below online training courses:

1) Project Management:

The Project Management course offered by Learning Tree International teaches participants to: manage and deliver successful projects for stakeholder satisfaction, apply best practices to plan a project using a proven five-step process, estimate and schedule task work, duration and costs with confidence, implement risk management techniques and mitigation strategies, and lead a project team and monitor project progress through successful execution.

2) Developing Your Leadership Voice for Presence and Impact:

This leadership course offered by Learning Tree International teaches participants to: communicate with authenticity to strengthen their effectiveness, implement a strategic approach that ensures intended results, engage, motivate and inspire others with carefully crafted messages, refine their communications with a variety of techniques, and manage challenging situations with confidence.

3) Systems Engineering:

Systems Engineering (SE) Fundamentals helps attendees to understand systems engineering processes, application, and its value to the successful implementations of the

systems developments projects. The course is a key to achieving reliable, efficient, cost-effective products and services in diverse fields, including communication and network systems, software engineering, information systems, manufacturing, command and control, and defense systems acquisition and procurement. The course also teaches techniques for accurately eliciting, analyzing, and specifying software requirements.

Mentorship and Tutoring: Scholars receive tutoring support as requested. Students are only required to secure tutoring if their GPA falls below a 3.0. In this case, they are given one semester of tutoring to increase their GPA to the minimum 3.0 level necessary for MUST renewal.

The MUST mentorship program strives to assist scholars in academic development, prepare scholars to be competitive candidates in the workplace, create an extended support network, and provide insight on graduate school. All scholars have the option of being placed with as many as three mentors: faculty, graduate, and peer.

PROJECT GOALS

Goal One: Support the development of STEM expertise leading to eventual degrees among groups that are currently underrepresented in the workforce, including women, minorities and persons with disabilities.

Goal Two: Provide support services such as mentoring to ensure that students successfully complete their coursework and encourage degree completion.

Goal Three: Provide hands-on research experiences that broaden interests in the aerospace industry.

Goal Four: Prepare students for a career in STEM by engaging them in professional development experiences.

PROJECT BENEFIT TO STRATEGIC GOALS 6 AND 5

The MUST project directly supports Strategic Goal 6 of the NASA Education portfolio by contributing to the accomplishment of the following Agency Performance Goals:

Strategic Goal 6: Share NASA with the public, educators, and students to provide opportunities to participate in our Mission, foster innovation, and contribute to a strong national economy.

Outcome 6.1: Improve retention of students in STEM disciplines by providing opportunities and activities along the full length of the education pipeline.
Outcome 6.4: Inform, engage, and inspire the public by sharing NASA's missions, challenges, and results.

Strategic Goal 5: Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.

Outcome 5.1: Identify, cultivate, and sustain a diverse workforce and inclusive work environment that is needed to conduct NASA missions.

PROJECT ACCOMPLISHMENTS FOR 2012-2013

Project Performance for Goal One:

Scholarships:

- MUST scholars were awarded $525,758 in scholarships.

Scholar Profiles:

- MUST continued to serve a very diverse group of students in 2012–13, although slightly less so than in the two previous years. Sixty-six percent of MUST Scholars were racial or ethnic minorities. Forty-nine percent of the scholars were female.
- Twelve students (16 percent) attended a Minority Serving Institution, similar to the 16 percent in 2011–12 and the 19 percent who attended in 2010–11.
- Fifty-eight universities across 26 states and Puerto Rico were represented.

Academic and Professional Interests:

- Fifty-four percent of scholars were majoring in engineering, 32 percent in science or math, and 12 percent in a space-related major (aerospace, aeronautics, astronautics, or astronomy).
- Ninety-four percent of MUST Scholars enrolled in at least one STEM class in the fall and 98 percent did so in the spring.
- Just over half of participants felt that participating in MUST had positively influenced their course selections.
- Forty percent of scholars reported their top career aspiration as working in aerospace, 24 percent in engineering, 9 percent in computers, 5 percent in education, and the remaining 20 percent in another science field or mathematics.

Project Performance for Goal Two:

Mentorship:

- About two-thirds of mentors worked with their MUST Scholar mentees for more than two hours per month.

- The most commonly discussed topics between mentors and scholars were graduate school, STEM-related research and professional opportunities, and recommendations.
- Mentor relationships helped scholars expand career options, set higher expectations, and help scholars feel that there were people to support them.
- Scholars discussed financial aid with MUST staff more than with their mentors.
- MUST Scholars highly prized the support and opportunity offered by the program's community of scholars, mentors, and staff. The mentorship, in particular, garnered particular praise from a great many students who valued the support and guidance their mentors offered.

Project Performance for Goal Three:

NASA Internship Experience:

- Scholars believed that their NASA internship helped them clarify their career plans (94 percent) and impacted their course of study (96 percent).
- Scholars reported that they developed their conceptual abilities (90 percent), teamwork (91 percent), and leadership (73 percent) through their internship.
- Sixty-one percent of scholars reported that they were members of at least on professional STEM organization.
- Forty-two percent of MUST Scholars presented at a conference during the academic year.

Project Performance for Goal Four:

Professional Development Activities:

- Ninety-seven percent of scholars in the fall sample and 95 percent of scholars in the spring indicated that they participated in at least one professional development activity that semester.
- Roughly 70 percent of scholars participated in at least two professional development activities, 45 percent participated in at least three activities, and 20-25 percent participated in four or more activities.
- Interview training, attending professional conferences and career fairs, and collaborating across networks were the top three types of professional development experienced across the year as reported by MUST Scholars.

- 59 percent of scholars in the fall semester and 66 percent in the spring semester reported engaging in outreach activities. The majority of these activities were mentoring or tutoring younger students in STEM fields.
- Ninety-four percent of the MUST Scholars who completed the spring survey attributed accomplishments in the fields of leadership and outreach, academic focus and grades, and research experiences to their involvement with MUST.

PROJECT CONTRIBUTIONS TO STRATEGIC GOALS 6 AND 5

Project Contribution to Outcome 6.1: The MUST Project supported this outcome by providing 74 students with scholarships, matching scholars with appropriate mentors, and providing professional development opportunities through online trainings as well as through the MUST Newsletter. Nationally, only 40% of students who enter college aspiring to earn a STEM degree complete one.[1] In 2013 MUST had a 95% retention/graduation rate. Of the 74 students beginning the academic year, 44 graduated and 27 renewed into MUST as a college junior or senior. Ten MUST scholars were recognized as NASA Ambassadors.

All renewing MUST scholars completed a NASA or STEM industry internship during the summer of 2013. In addition, 14 MUST graduates also conducted a NASA internship. The NASA experience helped to make STEM courses more relevant for scholars, increased their overall STEM capabilities, and supported them in developing a career plan.

Project Contribution to Outcome 6.4: MUST scholars participating in a NASA internship shared their experience and new knowledge with STEM professionals, college students, and the k-12 community across the nation. Sixty-six percent of MUST scholars engaged in outreach activities specifically targeting the K-12 community; the majority of these activities were mentoring or tutoring younger students in STEM fields. In addition, 42 percent of MUST scholars presented their NASA research and results at professional conferences.

Project Contribution to Outcome 5.1: Scholarship and internship awards of $525,758 and $206,000 respectively, were made to MUST students. The MUST 2013 cohort was 49 percent female and 66 percent racial or ethnic minorities. Sixteen percent of scholars attended a Minority Serving Institution. Scholars were located at 48 institutions across the United States and Puerto Rico.

ALUMNI OUTCOMES

[1] President's Council of Advisors on Science and Technology (PCAST), *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics* (Washington, DC: 2012).

The MUST scholars who graduated in spring 2013 continued into STEM fields for both their educational and employment plans. Table 1 shows the number of MUST Scholars and their field of undergraduate degree attainment. Five scholars reported having degrees in two fields.

Table 1: Number of MUST Scholars Receiving Undergraduate Degree and their Disciplines

Undergraduate major	Number
Mechanical Engineering	9
Electrical Engineering	7
Computer Science	5
Mathematics	5
Physics	5
Chemistry	2
Aerospace Engineering	1
Industrial Engineering	1
Computer Engineering	1
Astrophysics	1
Bachelor of Arts in Astrophysics	1
Biomedical Engineering	1
Biomedical Engineering	1
Biomedical Engineering	1
Chemical engineering	1
Computer science	1
Environmental Engineering, Earth and Planetary Science	1
Total	44

SOURCE: MUST Alumni Survey.

Sixty-two percent of alumni reported that they would enroll in graduate school immediately following graduation, 35 percent reported that they would enter the STEM workforce, and the remaining scholar received a Fulbright Fellowship. Of the alumni who will enter graduate school, Table 2 shows the disciplines in which they intend to receive their degree.

Table 2: Number of MUST Scholars Hoping to Receive Graduate Degrees in Different Fields

Graduate field of study	Number
Computer Science	3
Mechanical Engineering	3
Aerospace Engineering	2
Chemistry	2
Electrical Engineering	2
Physics	2
Applied Mathematics and Statistics	1

Aqueous Chemistry	1
Computational and Systems Biology	1
Geodetic Science	1
Industrial Engineering	1
Materials Science	1
Mathematics	1
Mechanical and Aerospace Engineering	1
Meteorology	1
Planetary Science	1

SOURCE: MUST Alumni Survey.

Eight scholars reported receiving fellowships, two received teaching assistantships, and one has received a research assistantship.

MUST PROJECT CONCLUSIONS

The results of the data analyses performed for this report provide evidence that the Hispanic Scholarship Fund Institute (HSFI) and NASA have been effective in accomplishing the goals it set out for this project.

- Scholars are from groups that are currently underrepresented in the workforce, including women and minorities.
- There is strong evidence that participation in MUST has helped scholars develop science, technology, engineering, and mathematics (STEM) expertise.
- MUST Scholars graduate with degrees in STEM fields and hold STEM career aspirations.
- MUST Scholars engage in hands-on research experiences that broaden interest in the aerospace industry.
- MUST Scholars engage in a variety of professional development experiences.
- MUST Scholars engage in a variety of outreach activities.
- MUST Scholars attend and present at conferences and join professional organizations.

IMPROVEMENTS IN THE PAST YEAR

The MUST Project continuously strives to provide students with a stronger support system and to demonstrate its outcomes to stakeholders. HSFI continued to place a strong focus

on evaluation to better understand how the program is working and the student experience. Based on the evaluation results, the below improvements from last year were expanded.

Resource Manual: MUST Presentation Opportunities: This guide lists professional and academic conferences focused on STEM where MUST scholars can improve their oral presentation skills and share their NASA experience with a larger community. It lists conferences by field of study and region and includes a range in the type and size of conferences so that students can choose a conference that will allow them to demonstrate their particular expertise or interest in a comfortable venue. This manual was updated and distributed to 2013 MUST scholars and their mentors.

MUST Newsletter and Facebook: The MUST Newsletter and Facebook have proved an effective means of communicating with scholars. The newsletter includes dates of important events, NASA information and opportunities, helpful links, scholar highlights, professional development materials, and more. It is distributed to 210 current scholars, alumni and mentors. The average open rate is 36.4% (approx 76 people), which is highe than the industry average of 21.8%.

The MUST Facebook page has 188 members including current scholars, project alumni, and MUST Project staff. The page shares information with its members on employment at NASA, education and professional development opportunities at NASA, STEM news articles, and highlights MUST scholar accomplishments. Scholars use this page to share information with each other and to plan for the NASA internship.

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The NASA MUST Project invited the NASA Harriett G. Jenkins Fellows to participate in the 2013 21st Century Leadership Symposium. However, the combination of budget cuts combined with a decreased number of students led MUST to offer online professional development training instead of the onsite event.